Magical Microbes!!

Soil Science Society of America

Type of Lesson
Hands-on

Materials Needed
- MudWatt kit
- Mud slurry

Time Required
15 minutes

NGSS Standards
- LS1.A
- LS2.B
- PS3.B
- PS3.D
- ETS1.A
- ETS1.B
- ETS1.C

Did you know that soil is a “biological incinerator”? Soil organisms decompose plant and animal wastes and human-produced wastes such as raw sewage and industrial chemicals. This decomposition is important because it releases nutrients that plants can take up through their roots, and it provides the organisms with energy.

So where does this energy come from? The energy released during decomposition results from complex biochemical reactions involving oxidation and reduction processes. Oxidation is the loss of electrons, and reduction is the gain of electrons. When a compound loses a fixed number of electrons, another compound gains that same number of electrons. The source of electrons for many living organisms is reduced carbon.

What is “reduced carbon”? Well, in the carbon cycle, microorganisms and plants take in carbon dioxide and “fix” it by adding electrons, forming carbohydrates. Some of this fixed carbon is used to make new cells and tissues, while the rest can be oxidized for metabolic energy, resulting in the liberation of carbon dioxide.

However, there are some funky bacteria that have evolved to release electrons into their surrounding environment. One of these is *Shewanella (Shewies).* *Shewies* are rod-shaped bacteria found everywhere on Earth.

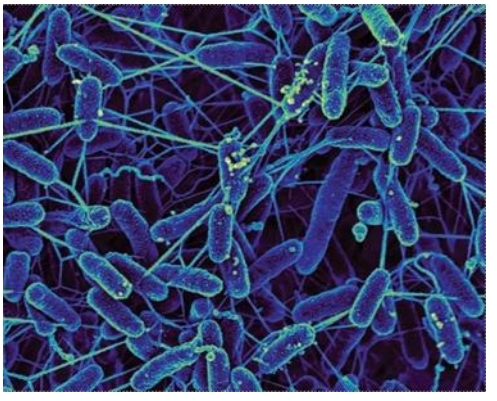

Figure 1-Shewganella bacteria connected by nanowires (Source: https://alchetron.com/Shewanella)

When oxygen is unavailable as an electron acceptor, they can use other electron acceptors for respiration, notably iron (Fe) and manganese (Mn) compounds. Chemical reduction of Fe and Mn compounds involves the extracellular transfer of electrons through electrically conductive appendages called nanowires, extensions of their outer membrane. By linking their nanowires, the *Shewies* create an electrical current in the soil that acts as a Microbial Fuel Cell (MFC) – a device that converts chemical energy to electrical energy through the metabolism of microorganisms like *Shewies*!

Could *Shewies* be a sustainable future clean energy source?

Want to learn how to construct your own MFC? Check out MudWatt:

MudWatt Teachers Guide

MudWatt Kit link